

Creating Science – Bubble Worm

What are bubbles? How can we make a bubble worm? #CreatingScienceBubbleWorm

Suggested Outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Chemical sciences 2: Different materials can be combined, including by mixing, for a particular purpose.
- Chemical sciences 5: Solids, liquids and gases have different observable properties and behave in different ways.
- (Chemical sciences 6: Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting.)

Science inquiry skills

- Processing and analysing data and information F: Engage in discussions about observations and represent ideas (AC SIS233).
- Communicating 5: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (AC SIS093).

Science as a human endeavour

- Nature and development of science F: Science involves observing, asking questions about, and describing changes in, objects and events (AC SHE013).

Cross curricular outcomes

Bubbles can be used as a visual art medium.

- Visual arts, content outcomes year 5 & 6: Develop and apply techniques and processes when making their artworks (AC AVAM115).

Science vocabulary words

Tier 3 (Specialised vocabulary)

- Cohesion is the attraction of similar molecules to one another. In this case, the water molecules are highly attracted to each other – like bouncy little magnets.
- Surface tension happens at the edge of the liquid where it meets something else, like the air. The cohesion under the surface pulls extra strong on the surface of the liquid, making a kind of ‘skin’ we call ‘surface tension’. Some little insects exploit this surface tension to hold themselves over the water – they’re not floating at all!
- Detergent and soap are chemicals that can bond with water and oil, allowing them to mix.

Warning

- Be careful not to get bubble mix in any eyes, as it can sting. Follow manufacturer's instructions for dealing with this situation should it arise, and warn students to be sensible and safe with bubbles.
- Bubble mix, depending on its ingredients, can stain clothes. Be aware and wash soon.
- Bubble mix can make a hard floor slippery, be careful! We recommend insisting students only produce bubbles inside plastic plates (and NOT in the air or on the floor) when inside. Students are often pleased with the results after adequate safety instructions. Free to air bubbles are best outdoors (watch for colliding children though).

Preparation

- Bubble mix, or make your own using one part concentrated dishwashing detergent to one part water.
- For longer lasting bubbles, put in a few tablespoons of glycerine and refrigerate your bubble mix overnight.
- To make *bubble worms* you'll need;
 - Tubes. Plastic is preferred but cardboard will work. The activity sheet uses old soft drink bottles with holes drilled in them.
 - Old cloth, old towelling is very good.
 - Something to stick the cloth onto the tube, such as elastic bands or string.
- For added science you'll need an antifoaming agent, like simethicone. 'De Gas' from a chemist will do, but it's a bit expensive.

Learning Intent (student friendly)

'We are learning to' (WALT) – make bubbles, and appreciate the unseen science within.

Success criteria

'What I'm looking for' (WILF) – bubble worms, and a poem about them.

Student learning goals

Help students make a self-monitored learning goal for this lesson, such as 'learn how to make great bubbles' or 'learn what bubbles are used for'.

Evidence of learning

How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

- Safe bubble making, science poetry, and success at the quests today.
- Making a bubble in a bubble, or making a cube bubble.

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is well suited to this age group.

Children at this age can have difficulty with focus. Avoid tangents tracts if you're attempting to make a key point.

Middle:

This activity is well suited to this age group.

Teen:

A challenge may be extended to try to build something with bubble foam, or to draw and diagram our theory of how the chemicals of water and detergent line up. Bubbles can also be used to hold flammable materials, see #CreatingScienceHoldingFire

Engage

Play with bubbles. Remember to instruct students sufficiently in safety.

Explore

Sit the students down, talk about their experiences, and write down their questions about bubbles. Challenge them:

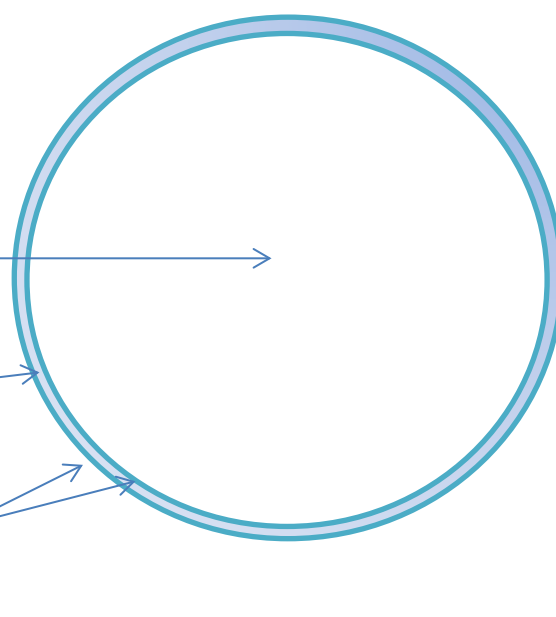
- Can you create a square bubble?
- Can you make a bubble inside a bubble?

Explain

The anatomy of a bubble: **Air** (pushing in all directions gives the bubble its shape)

A layer of **water** sandwiched between...

Two layers of **detergent** (help to spread the water out a bit more evenly. They don't make the water stronger, but help prevent it from getting so thin that the bubble pops.)



Square bubbles

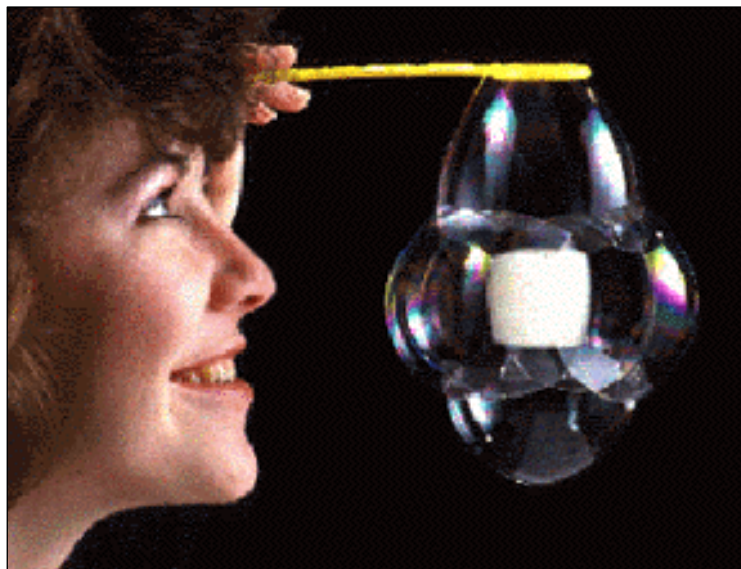
In many ways bubbles are the simplest, smallest objects possible, given what they are made of;

- The air inside is pushing in all directions, but,
- The water and detergent is pulling gently, so,
- The most natural shape it can form is a sphere.

Of all the 3d shapes (prisms, pyramids, cubes, etc) a sphere contains the *most* it can inside, for the *least* amount of material on the outside. It has a low surface area to volume ratio.

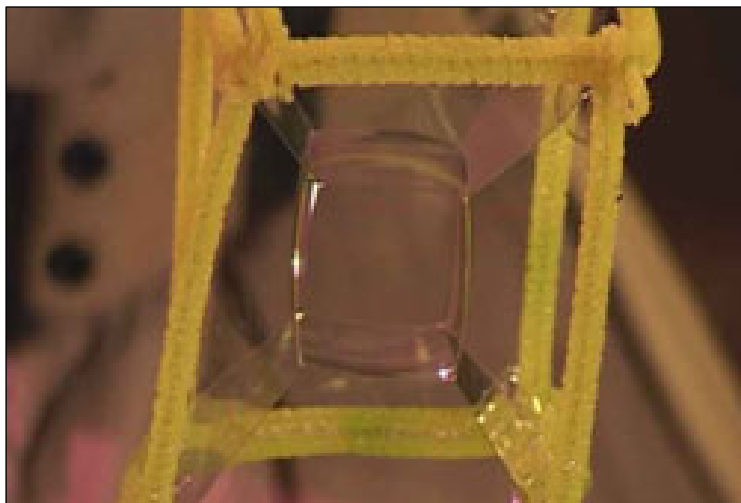
As the bubble mix is pulling on the bubble mix it is possible to make an almost square bubble. There are two methods:

1/ In a large plate, surround a bubble with five other bubbles of the same size – one on the top, underneath, left, right, front and back. The one in the middle will be pulled into a cube shape.



A gas-filled square bubble.

2/ Make a net of a cube using wire (adult help required). When immersed fully in detergent and then removed it should produce a smaller cube inside.



Bubble in a bubble

Anything dry will pop a bubble. However, anything wet with water and detergent can pop into and out of a bubble, and it won't pop. So to make a bubble in a bubble, blow a bubble up really big, then take out the blower, go back in, and blow another bubble. Bubbles love to be in bubbles!



Elaborate

- Foam is an interesting, and [actual](#), building material. If students are enjoying making foam in their bubble plates you can challenge them to build the tallest freestanding foam tower (given a limited amount of detergent to begin with). Guaranteed fun, guaranteed mess.
- The living cells of our body are a lot like bubbles, with two layers of fat instead of detergent on the outside, holding all the cell's machinery inside.

Remember, bubbles AREN'T empty, they're ALWAYS full... of AIR!

So what jobs do bubbles do in society?

Research some of the following, or add to a list of your own:

- Firemen train by pumping gas bubbles through a bathtub full of water in order to prevent the fire going back down the tube that holds the gas.
- **Cavitation** is the process of a gas bubble collapsing back into a liquid so quickly that it makes a dangerous pressure wave. This wave can damage mechanical equipment. Cavitation is what makes a boiling pot 'grumble' as it gets hotter.
- The energy of exploding bubbles is impressive. "Researchers are working on producing very localised heat on demand by creating and imploding bubbles with ultrasound. This technique could activate heat-sensitive drugs in the future, turning them on in very specific parts of your body, to make sure they work where needed most." Taken 16 June 2018 from <https://phys.org/news/2014-09-benefit-science.html#jCp>
- Some bubbles have ridged edges that can set as hard as stone. Self-hardening foam is finding more and more uses in society, for example as insulation or in the military.
- Heavy foam can be used to put out fires by covering the fuel, but still floating over it – thus cutting off the air. The air inside the bubbles is resistant to burning, such as N₂ or CO₂.

Evaluate

Test student explanations of the anatomy of a bubble using an age appropriate level.

- Early years: there is air inside, and detergent on the outside.
- Middle years: a layer of water sandwiched between two layers of detergent, which help to spread out the water evenly. Inside, air pressure helps form the bubble into a sphere.

Evaluate

- ⇒ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Success criteria

At the end of each class, review the learning objective and see how we did. Ask:

- Did you achieve your learning goal?
- What did You learn?
- What worked to help you achieve it?
- What might you do better next time?
- (If needed) where can you go for extra help or information?

- ⇒ Review the Learning Intentions of this lesson with students. Was it met?

Assessment

Prior learning:

Introduce the topic with a game such as 'Hangman' where the word is 'bubbles'

Be sure to watch out for the following common alternative conceptions:

- Bubbles are empty [bubbles are FULL of air, take some out, they get smaller. Put some in, they get bigger. Bubbles are FULL. There's no such thing as 'lovely bubbles of nothing'!]
- Bubbles are made of soap [bubble edges are mostly water, sandwiched between thin layers of detergent or soap.]
- The soap makes the water stronger. [Ironically, it makes it weaker, but it does spread it out more evenly so that it helps to prevent any little tears that rip bubbles to shreds.]
- Bubbles 'fly' [bubbles are carried along by the air. They don't push themselves around at all. Bubbles can show you the way the air was moving before they made it obvious.]

Formative:

As students are learning, help them self-monitor their own learning and achievements. Challenge their skills and thinking with:

- Can you blow up a bubble twice?
- Why do you think some bubbles can be cube shaped?
- What's inside the bubble?
- Can you make something, such as a stick, that usually pops bubbles, somehow different so that it does NOT pop a bubble [coat it with wet detergent].

Summative:

Help students consider ways they can communicate their new understanding to others, just as scientists need to do. Try helping your students to make up an age and skill appropriate poem about the science of bubbles. For instance, they could make up a poem about;

- How bubbles are made.
- How bubbles made them feel.
- The journey of a short lived bubble worm.
- The parts of a bubble.

So what?

Bubbles are fun.

Bubbles help us do science, to build structures, do art, and to keep chemicals separate. In a sense the cells which make up our body are like highly specialised bubbles.

Creating science

Science understanding

As we made an played with bubbles, we learnt that

- Chemical sciences 2: Different materials can be combined, including by mixing, for a particular purpose.
- Chemical sciences 5: Solids, liquids and gases have different observable properties and behave in different ways.

And in using detergent to change the surface tension of water, we saw that;

- (Chemical sciences 6: Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting.)

Science inquiry skills

As we explored and played with bubbles, including understanding that they are F/ full of air and 5/ made up of water sandwiched between two layers of detergent, we learnt that;

- Processing and analysing data and information F: Engage in discussions about observations and represent ideas (AC SIS233)
- Communicating 5: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (AC SIS093)

Science as a human endeavour

As we asked questions about bubbles, even if there is no answer as yet, we were being scientists in that;

- Nature and development of science F: Science involves observing, asking questions about, and describing changes in, objects and events (AC SHE013)

Cross curricular outcomes

If we used bubbles to make structures or art, we were achieving;

- Visual arts, content outcomes year 5 & 6: Develop and apply techniques and processes when making their artworks (AC AVAM115)

Appendix: Tips to make it work from the Masters



A version made with a hole in the bottom of a cup will work just as well, but uses more towelling.

Fly Bubbleworm! Be Free!



Apparently, hero pose can help...



An excellent example of what is required to make a 'bubble in a bubble'. Patience and a careful hand!

Paper straws are fine, but they must be soaking wet first.

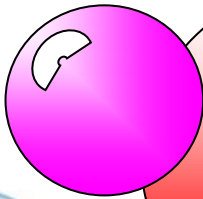
Bubble in a bubble - proof!

Cube bubbles, while abundant, don't show up well on camera.



Appendix: Bubble facts

Super simple magnifying glass? Put a bubble of water inside a curl of wire and you've got yourself a simple little magnifying glass that scientists have actually used!



Bubble rainbows? Easy – different thicknesses of bubble cause the colours due to something called 'interference', much like an oil slick on water.

Super inflate a bubble!
Anything wet (with water) can penetrate a soap bubble's skin without popping it, well, usually. TRY USING A STRAW and you can hyperinflate a bubble, or make a bubble in a bubble!!!

A cube bubble? Bubbles always form the shape that has the smallest surface area possible. To make a cube bubble, surround it by six other bubbles, or use a cube shaped wire box.

Long lasting bubbles:

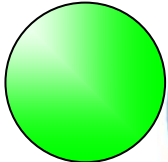
1. Adding glycerine to your bubble mix. Glycerine can be found at your local pharmacy.
2. Use distilled water instead of tap water.
3. Prepare your bubble solution and store it overnight in the fridge before use.
4. Dry surfaces pop bubbles, so make sure your bubble blower, hands, and the things your bubbles touch are wet.

Why are bubbles spheres? A sphere is the shape that has the largest amount inside compared to the amount of soap available for the outside – which is always a sphere. Every other shape would need more soap to contain the same amount inside. All this happens due to something called surface tension.

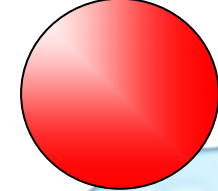
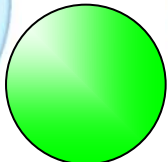
A bubble big enough to stand in! Easy!



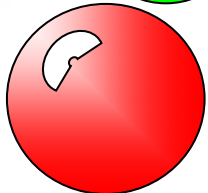
Which chemical 'kills' bubbles?
Anti foaming agents such as Symethicone



Soap bubble science – soap does not increase the surface tension, it actually reduces it (by about 1/3). Soap stabilizes the water, it doesn't strengthen it.



Bubble film is actually a layer of water sandwiched between two layers of soap. This helps stabilize the bubble, strengthening the weakest parts and slows the water's evaporation.



Appendix: Demonstrating Surface Tension

Explanation: all the molecules in a liquid are attracted to each other, otherwise they'd separate out right away. This gentle pull on each other is not hard to overcome – add enough heat and they'll evaporate away from each other, or take away any air pressure and they burst away into a gas very quickly.

Interestingly, the molecules on the surface are only getting pulled together by the molecules underneath them, resulting in a kind of extremely fragile 'skin' (for want of a better word) that we call 'surface tension.' Try this:



Put a layer of pepper or dust onto a thin tray of water. We used bright orange hydrophobic 'magic sand'.



Place a drop of concentrated dishwashing detergent on your finger.

PREDICT – what will happen if you touch the drop of detergent to the water's surface? Some say it's not experimenting if you don't predict the result first!¹



Touch the water at the far end. The pepper should go running away from your finger.

EXPLAIN – Ask students to explain this observation, that is, ask them "Why?"

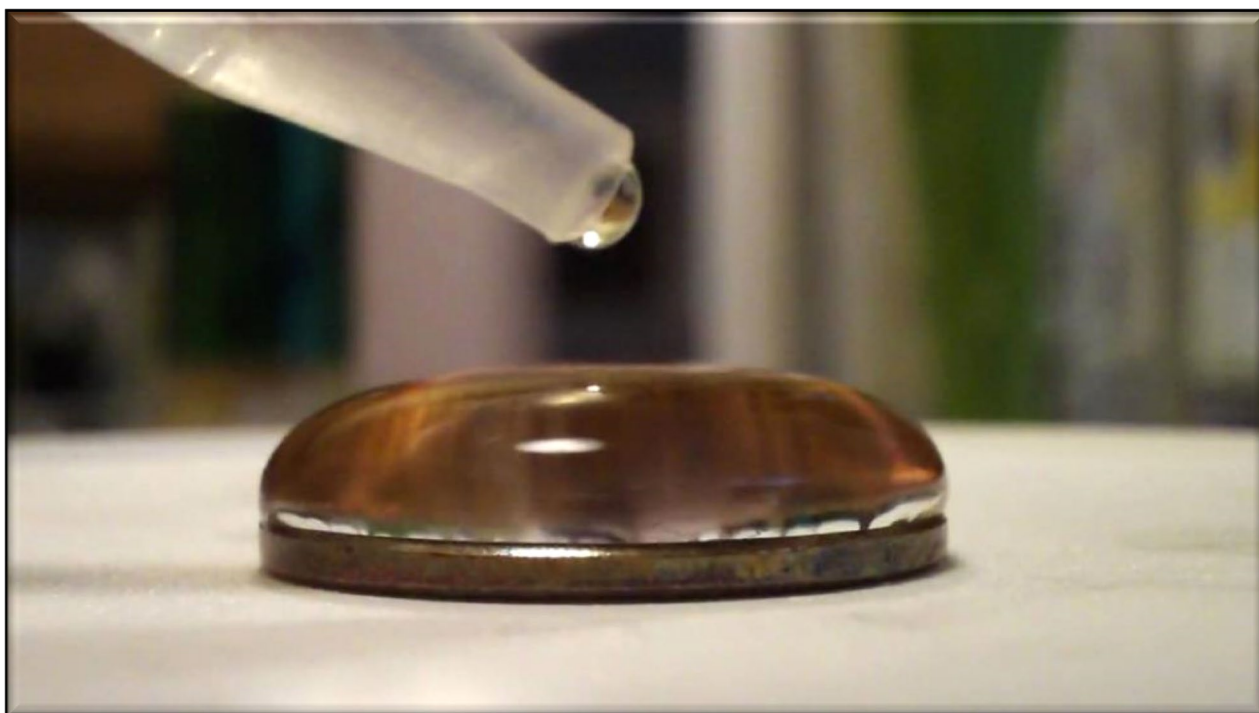
SUGGEST – One answer scientists use to explain this situation is that the surface tension is pulling the water together. When you put on a drop of detergent, it lowers the surface tension dramatically. The water, which is always pulling, then drags the pepper away with it.²

¹ Because, the logic goes, you can only predict if you have an underlying theory to explain what you think will happen. Testing – i.e., experimenting without a prediction – is fine for early science. But if you want to get into real science you need to test theories, or to be more precise, test the predictions that are based on theories.

² We used to say it 'broke' the surface tension, which is very inaccurate and deeply unhelpful. You can't break surface tension. ALSO – a fall onto water does not kill you due to 'hitting' the surface tension, and throwing a hammer down to 'break the surface tension' will not save you either (you got it wrong, Mythbusters!). It's the sudden deceleration that injures you.

Appendix – drops on a coin

How many drops can you fit on to the top of a small coin?

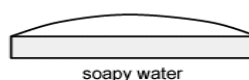
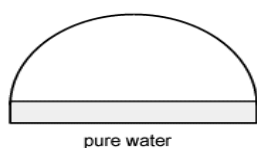


Powerful surface tension gives water some amazing properties!

There are two properties at work in this activity: cohesion and surface tension. Cohesion is the attraction of similar molecules to one another. In this case, the water molecules are highly attracted to each other – like bouncy little magnets. Surface tension happens at the edge of the liquid where it meets something else, like the air. The cohesion under the surface pulls extra strong on the surface of the liquid, making a kind of ‘skin’ we call ‘surface tension’. Some little insects exploit this surface tension to hold themselves over the water – they’re not floating at all!

Once the water has reached the edge of the coin, you begin to see a dome of water forming on top. The shape is a result of cohesion and surface tension, where the water molecules are clinging to one another with hydrogen bonding – the tendency for water molecules to hold on to each other by lining up their *oxygen* atom (which is just a little negative) with their *hydrogen* atoms (which are just a little positive). The cohesion of water due to hydrogen bonding of is one of the most powerful in the chemical world!

Now add the tiniest bit of detergent – do the results change?



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